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TITLE:

Integrated EM technologies map contamination plumes, seeps, geohazards – faults and possible migration pathways - at Barite Hills/Nevada Gold Fields EPA Superfund Site in South Carolina, USA.

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ABSTRACT BODY:

Abstract Body: Investigation of the near subsurface for geohazards can be conducted remotely with Natural Sourced Electromagnetic Methods (NSEM) using lightning strike technology. This study compares various EM-related technologies over the Barite Hills/Nevada Gold Fields mines in Late Proterozoic and early Paleozoic rocks of the Carolina slate belt; rich in gold and iron sulfides. These mines were active from 1989 to 1995. USGS and EPA site investigations of the mines in 2003 resulted in declaring the waste pit areas a superfund site.

The objective of these surveys was to evaluate shallow groundwater flow patterns that might help find or anticipate contamination seeps. The USGS used 2-D conductivity surveys and a private contractor used 3-D electromagnetic surveys to evaluate subsurface water flow paths, faults, and other groundwater-related features. Porous sediments, contaminated water, and mine debris have high conductivity whereas bedrock was identified by its low conductivity readings.

The consulting contractor integrated EM technology, magnetic, and shallow well data to generate 3-D images of groundwater flow paths at given depths across the superfund site. As a result, several previously undetected faults were identified. Lighting strike data was recently generated over the area of the mines and integrated with the prior study results to determine if this form of natural-sourced EM data could complement the more traditional geophysical data types described above. Several lightning attributes derived from 3-D lightning volumes (Apparent Resistivity, Apparent Permittivity, Peak Current, and Tidal Gravity), were found to correlate to various potential geohazard features identified in the previous studies. Most significantly, Peak Current showed a strong correlation with the preferred groundwater flow map identified by the contractors utilizing EM technology.

This new lightning technology enables E&P site planners to image and avoid shallow sub-surface flow paths which could provide a conduit for spills and result in costly cleanups. Identifying near subsurface flow paths, possible hydrocarbon migration pathways, natural seeps, and surface faults could be a valuable part of any environmental hazard management and spill recovery plan. This study demonstrates the utility of robust integrated EM technology applications for projects focused on hydrology and geohazards to dams, levees, and structures, as well as mineral and hydrocarbon exploration.